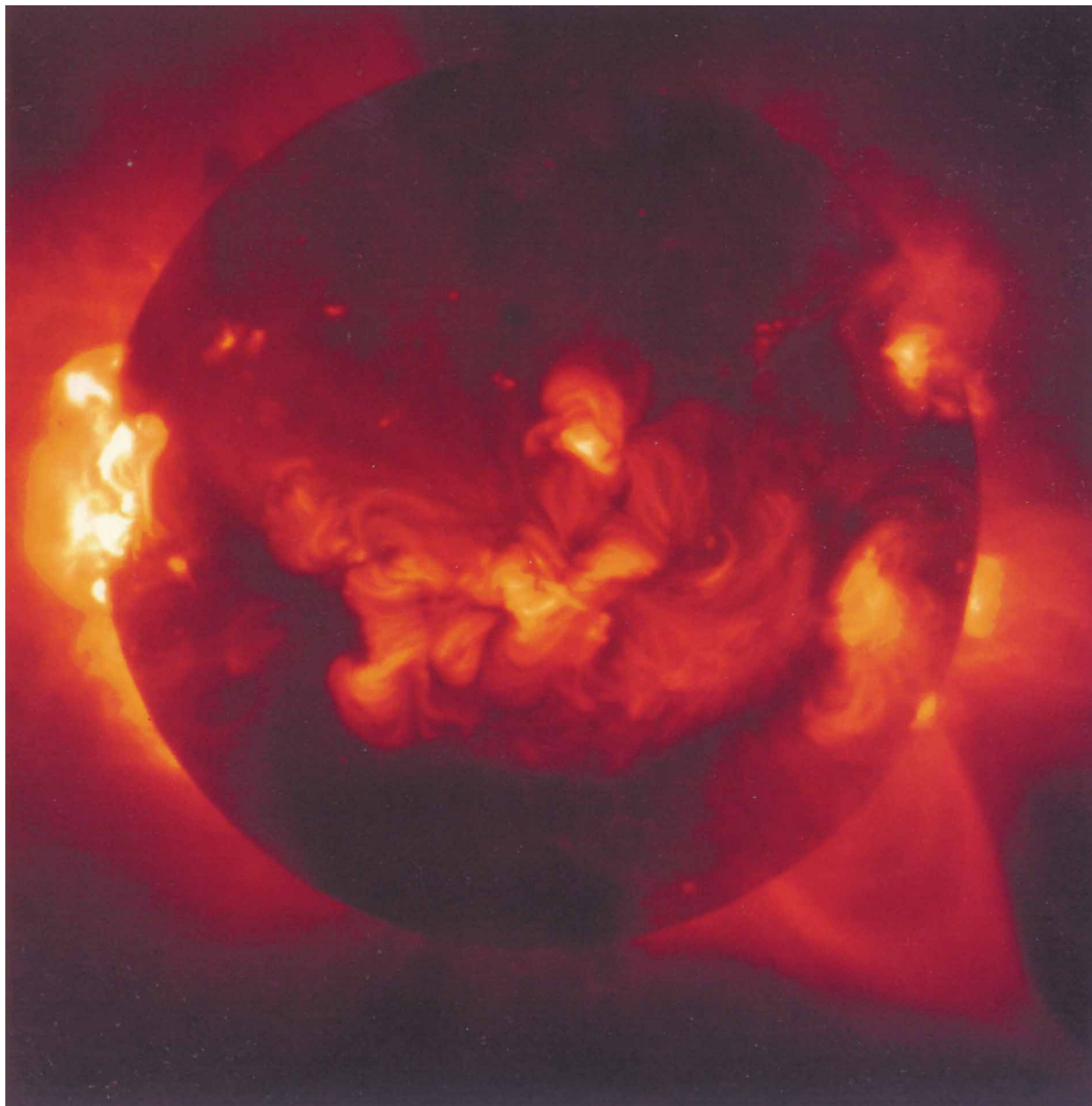




National Aeronautics and
Space Administration

Our Star—The Sun ☉





The **SUN** has inspired mythology in many cultures including the Ancient Egyptians, the Aztecs, the Native Americans, and the Chinese. In these and other cultures, the Sun was seen as everything from a war god to a hummingbird. The Ancient Chinese believed there were actually ten suns. We now know that the Sun is a huge, bright sphere of mostly ionized gas about 5 billion years old and is the closest star to Earth at a distance of 145 million km (one Astronomical Unit). The next closest star is 300,000 times further away. There are probably millions of similar stars in the Milky Way galaxy (and even more galaxies in the Universe), but the Sun is the most important to us because it supports life on Earth. It powers photosynthesis in green plants and is ultimately the source of all food and fossil fuel. The Sun's power causes the seasons, the climate, the currents in the ocean, the circulation of the air, and the weather in the atmosphere.

The Sun is some 333,400 times more massive than Earth (mass = 1.99×10^{30} kg), and contains 99.86% of the mass of the entire solar system. It is held together by gravitational attraction, producing immense pressure and temperature at its core (more than a billion times that of the atmosphere on Earth, and a density about 160 times that of water).

At the core the temperature is 16 million degrees Kelvin (K) which is sufficient to sustain thermonuclear fusion reactions. The released energy prevents the collapse of the Sun and keeps it in gaseous form. The total energy radiated is 383 billion trillion kilowatts/second, which is equivalent to that generated by 100 billion tons of TNT exploding each second.

In addition to the energy-producing solar core, the interior has two distinct regions: a radiative zone and a convective zone. From the edge of the core outward, first through the radiative zone and then through the convective zone, the temperature decreases from 8 million to 7,000°K, and density decreases from 20 gm/cm³ to 4 X 10⁻⁷ gm/m³. It takes about 10 million years for photons

to escape from the dense core and reach the surface. Because the Sun is gaseous, it rotates faster at the equator (26.8 days) than at the poles (as long as 35 days).

The Sun's "surface," known as the photosphere, is just the visible 500 km thick layer from which most of the Sun's radiation and light finally escapes, and is the place where sunspots are found. Above the photosphere lies the chromosphere ("sphere of color") that may be seen briefly during total solar eclipses as a reddish rim, caused by hot hydrogen atoms, around the Sun. Temperature steadily increases with altitude up to 50,000°K, while density drops to 100,000 times less than in the photosphere. Above the chromosphere lies the corona ("crown"), extending outward from the Sun in the form of the "solar wind" to the edge of the solar system. The corona is extremely hot—millions of degrees Kelvin. The process that heats the corona is very mysterious and poorly understood, since the laws of thermodynamics state that heat energy flows from a hotter to a cooler place. Mysterious phenomena, such as this, are studied by researchers in NASA's Space Physics Division.

Significant Dates

585BC—	First solar eclipse successfully predicted.
1610—	Galileo observes sunspots with his telescope.
1650–1715—	Maunder Sunspot Minimum discovered.
1854—	First connection made between solar activity and geomagnetic activity.
1868—	Helium lines first observed in solar spectrum.
1908—	First measurement of sunspot magnetic fields taken.
1942—	First radio emission from Sun observed.
1946—	First observation of solar ultraviolet using a sounding rocket.
1946—	1,000,000° K temperature of corona discovered via coronal spectra lines.
1949—	First observation of solar x-rays using a sounding rocket.
1954—	Galactic cosmic rays found to change in intensity with the 11-year sunspot cycle.
1956—	Largest observed solar flare occurred.
1959—	First direct observations of solar wind made by Mariner 2.
1963—	First observations of solar gamma rays made by Orbiting Solar Observatory I (OSO1).
1967—	First measurement of solar neutrino flux taken.
1973–4—	Skylab observed Sun, discovered coronal holes.
1982—	First observations of neutrons from a solar flare by Solar Maximum Mission (SMM).
1994–5—	Ulysses flies over polar regions of Sun.

Fast Facts

Spectral Type of Star	G2 V
Age	4.5 Billion Years
Mean Distance to Earth	150 Million Kilometers
Rotation Period (at equator)	26.8 days
Radius	695,000 Kilometers
Mass	1.99×10^{30} Kilograms
Composition	Hydrogen 71%, Helium 26.5%, Other 2.5%
Effective Surface Temperature	5,770 K
Energy Output (Luminosity)	3.83×10^{26} ergs/sec
Solar Constant	0.1368 Watts/cm ²
Inclination of Solar Equator to Ecliptic	7.25°

About the Image

This image of the Sun, taken January 24, 1992, is viewed from space at x-ray wavelengths. The image, as seen by the Soft X-ray Telescope on the Japan/US/UK Yohkoh Mission (orbiting solar observatory), reveals the hot, three-dimensional geometry of the corona across the full disk of the Sun. The large bright areas are regions where the Sun's magnetic field is so strong that it can trap hot gasses even though the temperature of the region is over 1 million degrees K. The dark areas are coronal holes, which are the origin of streams of particles, called the high speed solar wind, that flows past Earth and through the solar system at about 700 kilometers per second.

References

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<http://bang.lanl.gov/solarsys/sun.htm>
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